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www.soil-discuss.net/2/C593/2015/

Interactive comment on "Non-stationarity of electrical resistivity and soil moisture relationship in heterogeneous soil system: a case study" *by* D. Michot et al.

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Answer to reviewer #1 comments. We kindly thank the reviewer for his useful comments and suggestions. Comments led to an improvement of our manuscript. Answer to all comments can be found below. Added text is indicated in yellow (see revised version attached). Please find attached the figures and Supplementary materials. Referee #1

S 961, 8: "A horizon increased from 0.4 to 1.1m" Can you please add a scale to Figure 1 on the left side otherwise it seems that "ploughed organo mineral A" and "mineral A" are almost 1m.

A scale was added to Fig. 1

S 961: Can you please give some explanations to the predominant pedogenesis. For me it is not clear why soil types of such a different structure appear in direct neighborhood.

In hedged landscapes such as those in Brittany, the effects of landscape structures on soil pedogenesis and properties were clearly identified and described by Follain et al. (2009). Dynamics of the geometry of the organo-mineral A horizon in space and time was studied using 1) soil geometry analysis along trenches in relation to hedge distance, 2) historic document analysis, and 3) absolute dating of soil horizons. Follain et al. (2009) showed that A horizon geometry is clearly influenced by landscape structures, whereas deeper horizons are not influenced by them. Two paragraphs were added to the text: P6, l16 to l18 : "The geometry and properties of these pedological horizons vary greatly over small spatial scales, according to previous observations in a similar hedged landscape (Walter et al., 2003; Follain et al., 2009).".

P6, l25 to 31 : "The complexity of this soil spatial organization within hedged landscape is controlled by past and recent redistribution processes e.g. hydric and tillage erosion. Also, past and recent hedgerow network design may influence soil organisation as highlighted by Follain et al. (2009). A horizon thickness increasing from upslope to hedge location are due to anti-erosive effect of hedge as a barrier. Soil horizon organization differed slightly below the hedgerow, particularly under anthropogenic topographical singularities as the ditch and in the soil bank (Fig. 1)."

Figure S4 I suggest to put this figure in the text.

As suggested by the second reviewer, interpolation of soil matric potential can lead to inconsistent maps with negative values of matric potential below the surface free from groundwater. In Thomas et al. (2012), we published matric potential maps from simulations of water flow. We feel that it is not relevant to add more information to the present manuscript. We removed Fig. S4 from the Supplementary material.

Figure 4: Can you please use a similar colour ramp as for Figure S4. Which interpolation method you used, please explain in the text.

Fig. S4 was removed from the Supplementary material, and we kept the color of Fig. 4.

Figure 8: The correlation of the WS model to the Van Genuchten model is best for high ER. Please explain why?

As suggested in Laloy et al. (2011) , among five petro-physical models tested on a loamy soil to predict VWC and soil bulk density, the Waxman and Smits model appeared more consistent for electrical resistivity values > 100Ωm (Laloy et al., 2011), which are often observed in dry soils. For lower ER values (<100Ωm), the volume-averaging method (Pride, 1994; Linde et al., 2006) outperformed other tested models. The bad results obtained from WS model are probably related to the inconsistency in parameters which are not relevant for wet soils.

Figure 9: please translate "Linéaire" into English

We apologize for "frenchifying" the manuscript; "linéaire" was replaced by "linear".

Please also note the supplement to this comment:
http://www.soil-discuss.net/2/C593/2015/soild-2-C593-2015-supplement.zip

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Interactive comment on SOIL Discuss., 2, 955, 2015.

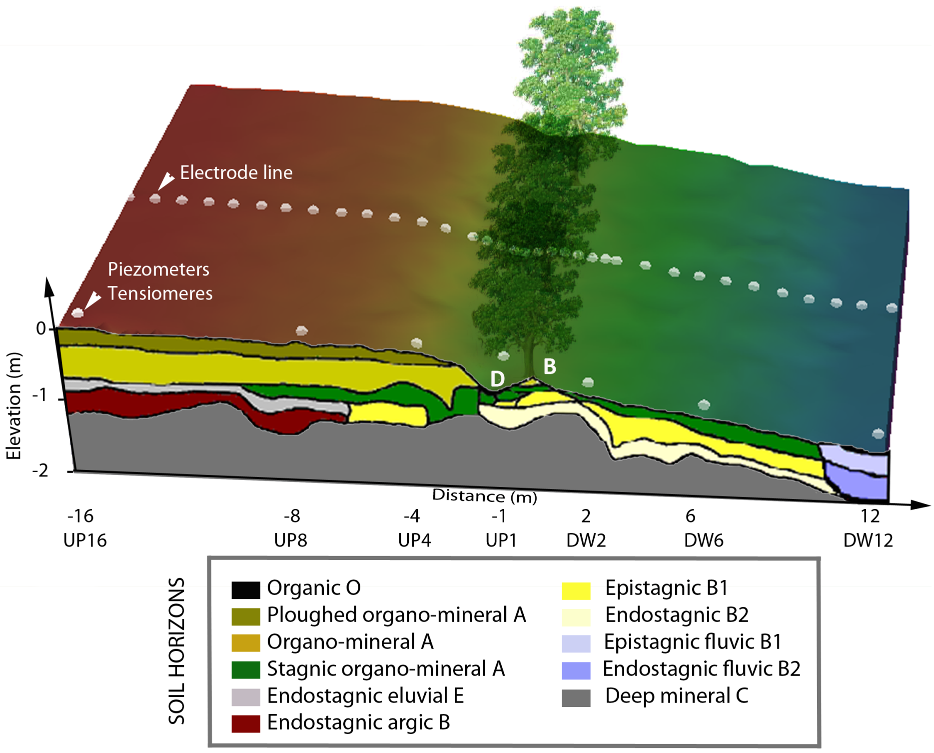
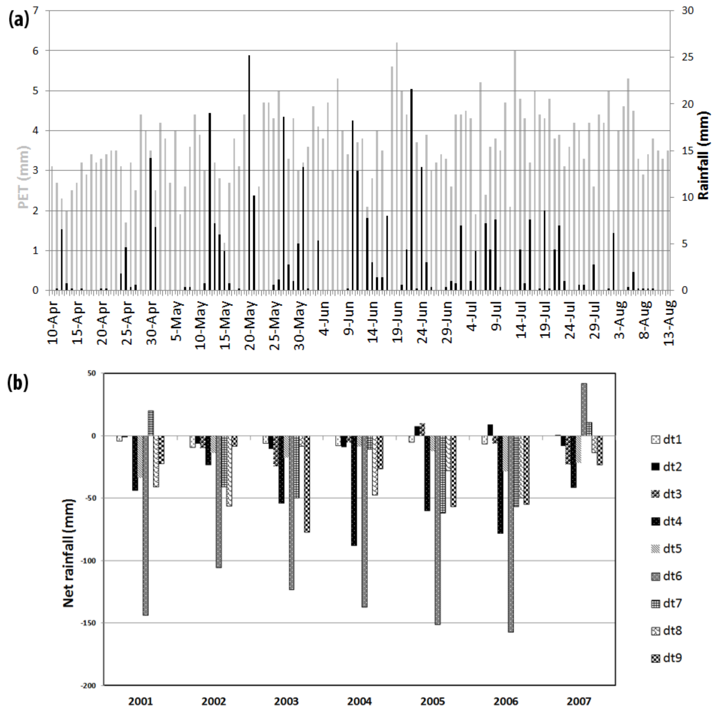
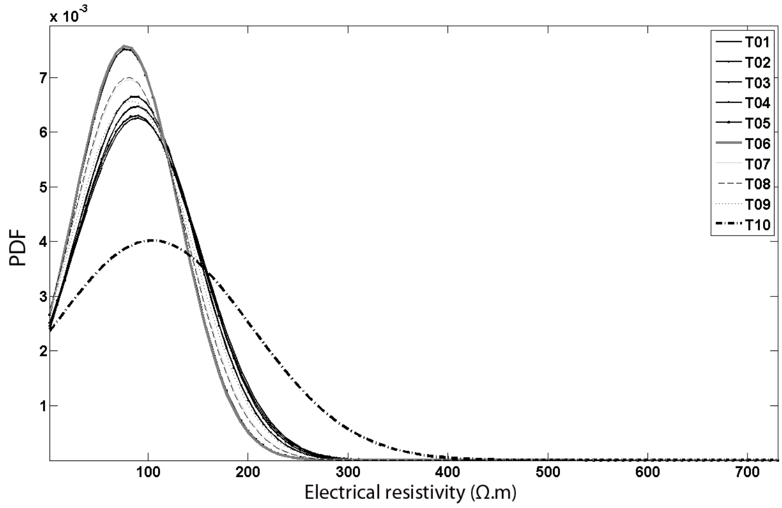


Fig. 1.



(a)
(b)
PET (mm)
Rainfall (mm)
Net rainfall (mm)
dt1
dt2
dt3
dt4
dt5
dt6
dt7
dt8
dt9
2001
2002
2003
2004
2005
2006
2007

Fig. 2.



x 10^-3
PDF
Electrical resistivity (Ω.m)
T01
T02
T03
T04
T05
T06
T07
T08
T09
T10

Fig. 3.

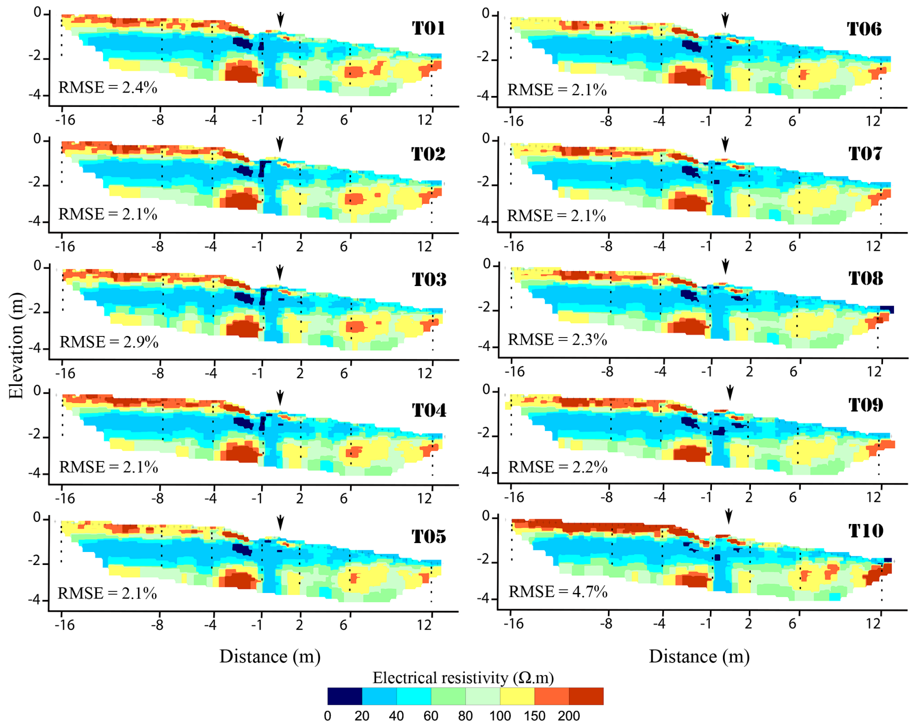

T01
T02
T03
T04
T05
T06
T07
T08
T09
T10
RMSE = 2.4%
RMSE = 2.1%
RMSE = 2.9%
RMSE = 2.1%
RMSE = 2.1%
RMSE = 2.1%
RMSE = 2.1%
RMSE = 2.3%
RMSE = 2.2%
RMSE = 4.7%
Elevation (m)
Distance (m)
Distance (m)
Electrical resistivity (Ω.m)
0 20 40 60 80 100 150 200

Fig. 4.

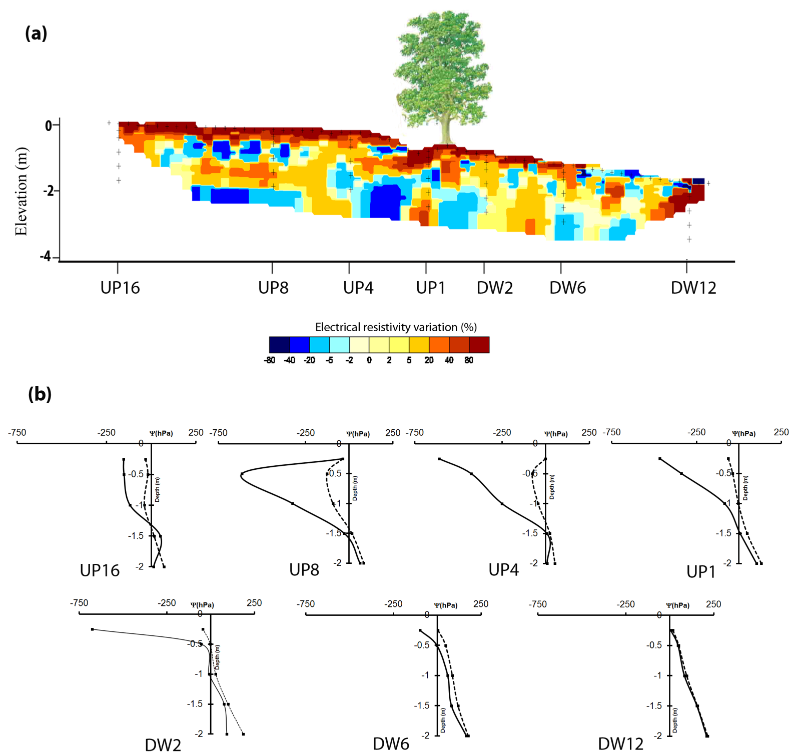

(a)
Elevation (m)
UP16
UP8
UP4
UP1
DW2
DW6
DW12
Electrical resistivity variation (%)
-80 -40 -20 -5 -2 0 2 5 20 40 80
(b)
Ψ(hPa)
Depth (m)
UP16
UP8
UP4
UP1
DW2
DW6
DW12

Fig. 5.

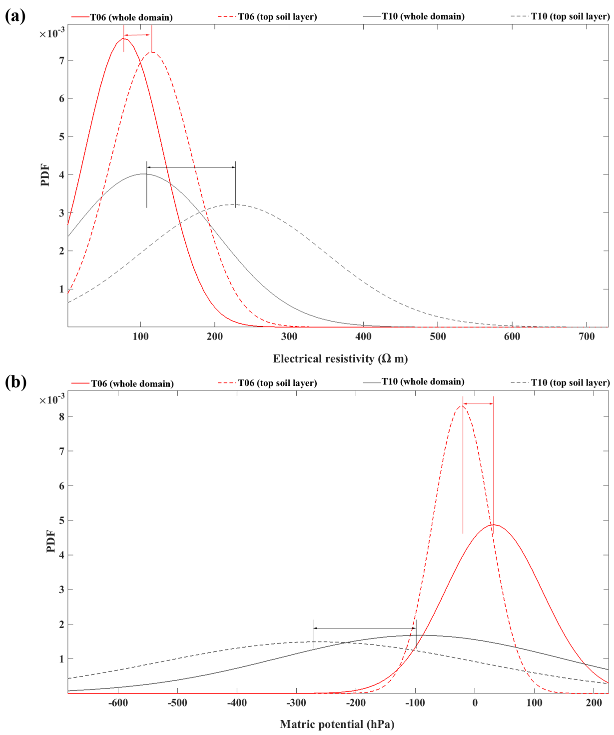

(a)
T06 (whole domain)
T06 (top soil layer)
T10 (whole domain)
T10 (top soil layer)
PDF
Electrical resistivity (Ω m)
(b)
Matric potential (hPa)

Fig. 6.

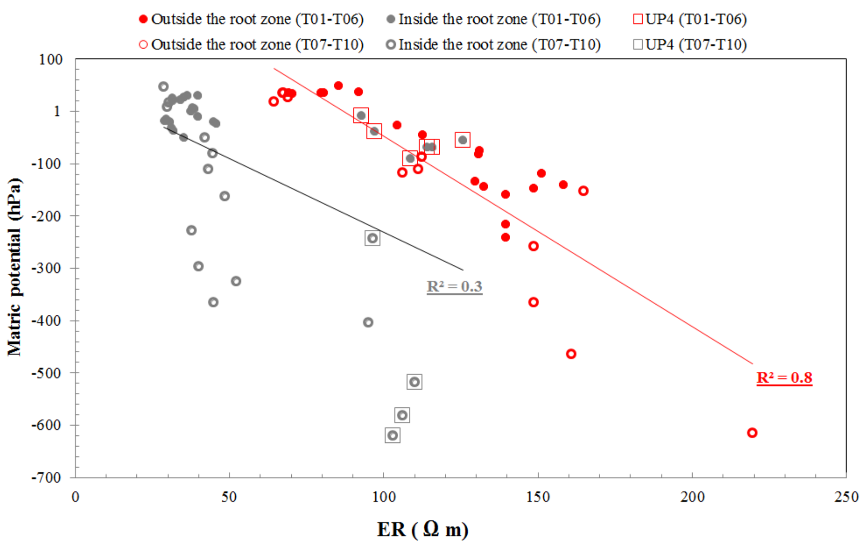

Outside the root zone (T01-T06)
Inside the root zone (T01-T06)
UP4 (T01-T06)
Outside the root zone (T07-T10)
Inside the root zone (T07-T10)
UP4 (T07-T10)
Matric potential (hPa)
ER (Ω m)
R² = 0.3
R² = 0.8

Fig. 7.

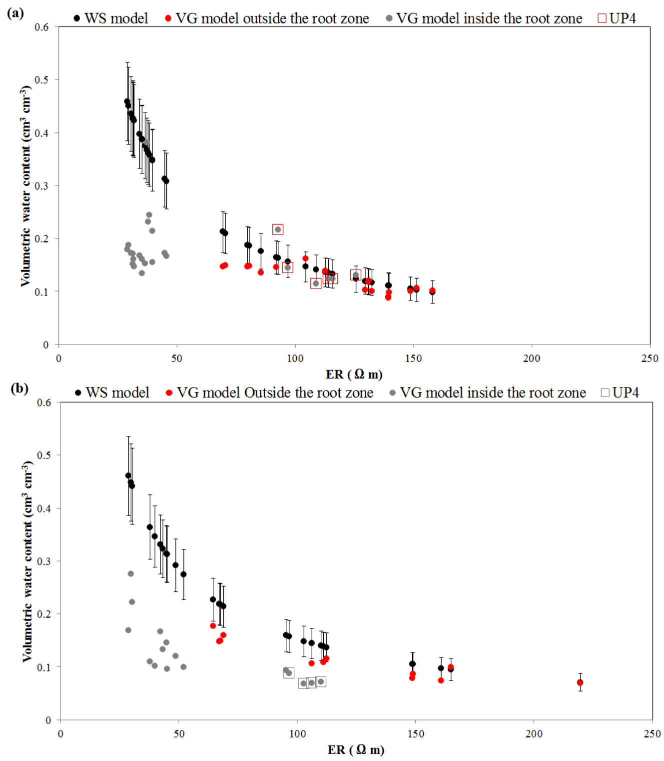

(a)
WS model
VG model outside the root zone
VG model inside the root zone
UP4
Volumetric water content (cm³ cm⁻³)
ER (Ω m)
(b)
WS model
VG model Outside the root zone
VG model inside the root zone
UP4
Volumetric water content (cm³ cm⁻³)
ER (Ω m)

Fig. 8.

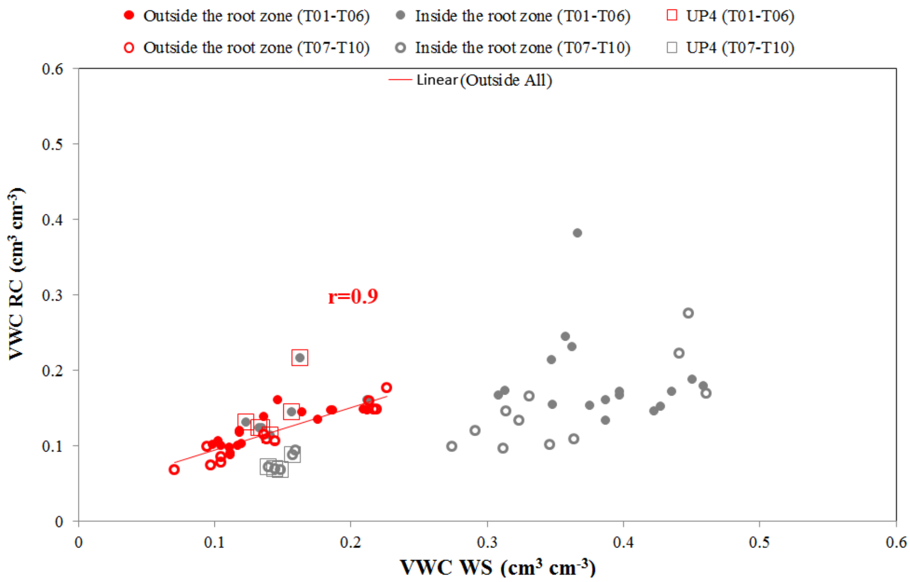

Outside the root zone (T01-T06)
Inside the root zone (T01-T06)
UP4 (T01-T06)
Outside the root zone (T07-T10)
Inside the root zone (T07-T10)
UP4 (T07-T10)
Linear(Outside All)
r=0.9
VWC RC (cm³ cm⁻³)
VWC WS (cm³ cm⁻³)

Fig. 9.

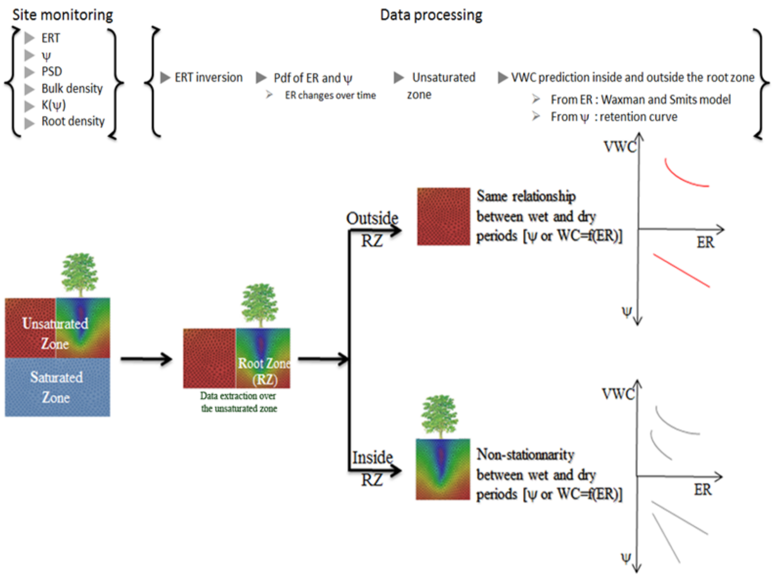

Site monitoring
ERT
ψ
PSD
Bulk density
K(ψ)
Root density
Data processing
ERT inversion
Pdf of ER and ψ
ER changes over time
Unsaturated zone
VWC prediction inside and outside the root zone
From ER : Waxman and Smits model
From ψ : retention curve
Unsaturated Zone
Saturated Zone
Root Zone (RZ)
Data extraction over the unsaturated zone
Outside RZ
Same relationship between wet and dry periods [ψ or WC=f(ER)]
VWC
ER
ψ
Inside RZ
Non-stationnarity between wet and dry periods [ψ or WC=f(ER)]
VWC
ER
ψ

Fig. 10.